Section II (Remarks)

Request for Two Months Extension of Time Under 37 CFR § 1.136

Petition hereby is made for a two months extension of time for reply to the August 23, 2007 Office Action, extending the deadline for response to January 23, 2008.

The fee of $230.00 specified in 37 CFR § 1.17(a)(2) for such two months extension of time is being paid by on-line payment at the time of EFS submission of this response.

Authorization is hereby given to charge the amount of any fee or other deficiency for this response, to Deposit Account No. 08-3284 of Intellectual Property/Technology Law.

Amendment of the Claims

The claims have been amended herein, to cancel claim 31 and to incorporate the substance of such claim in amended claim 2. In addition, such claim 2 has been amended in minor respects to improve the grammatical correctness thereof, and the phrase "at high concentration while producing little or no other organic acids" has been deleted.

Claim 32 has also been amended to delete the phrase "while producing little or no other organic acids" as well as the word "only" so that the claim now recites that "the rumen bacteria are homo-fermentative bacteria that produce succinic acid."

The finalization of the restriction/election requirement in the August 23, 2007 Office Action is acknowledged, and claims 1, 3-7, 10-30 and 33-35 have been identified as withdrawn in the preceding listing of claims in Section I.

No new matter has been introduced by the amendment of claims herein (35 USC 132).

Claim Objection to Claim 2

In the August 23, 2007 Office Action, Claim 2 was objected to as reciting "mutant which" in line 1 and "and has the property" in line 3. The Examiner proposed grammatical corrections and such corrections have been made in claim 2, to overcome such objection.

Rejection of Claims Under 35 USC § 112, Second Paragraph

In the August 23, 2007 Office Action, claims 2 and 32 were rejected under 35 USC § 112, second paragraph as indefinite for failing to particularly point out and distinctly claim the subject matter of the invention. Specifically, claim 2 was rejected for recital of "high concentration" as being confusing for lack of clarity. This rejection has been obviated by deletion of the phrase containing such term in claim 2.

Claims 2 and 32 were also been rejected on § 112, second paragraph grounds for reciting "little other organic acids" and claims 2 and 32 have been amended to delete such recitals, thereby overcoming this rejection.

Rejection Under 35 USC § 112, First Paragraph

In the August 23, 2007 Office Action, claims 2 and 31-32 were rejected under 35 USC § 112, first paragraph, on written description grounds.

This rejection was based on the contention that the specification does not teach the structures of all lactate dehydrogenase, pyruvate formate-lyase, phosphotransacetylase and acetate kinase of all rumen bacterial strains, or show that the ldhA, pfl, pta and ackA genes of the disclosed strain are representative of the genes of all disclosed rumen bacteria. The Office Action at page 5 thereof acknowledges that the specification teaches the mutant strain recited in claim 8 or 9, but the Office Action contends that one skilled in the art could not reasonably conclude that the applicant had possession of the broadly claimed invention at the time the instant application was filed.

Claims 2 and 31-32 were also rejected under 35 USC § 112, first paragraph as not being enabling (other than enablement for the rumen bacteria mutant strain recited in claims 8-9) for any rumen mutant bacteria having disruption of any lactate dehydrogenase, pyruvate formate-lyase, phosphotransacetylase or acetate kinase so that it produces succinic acid under anaerobic conditions.

This rejection was based on the assertion that one of ordinary skill in the art would not be able to make and use any rumen bacteria without undue experimentation to first find which rumen bacteria in fact comprise the specific class of genes, and then determine how to disrupt them without knowing their structure.

Further, claims 8 and 9 have been rejected under 35 USC § 112, first paragraph as reciting novel mutant bacterial strains that have not been fully disclosed or shown to be publicly known and freely available.

In response to the foregoing rejection of claims on 35 USC § 112, first paragraph grounds, the scope of claim 2 has been delimited. Claim 2 as amended herein recites rumen bacteria selected from the group consisting of genus *Mannheimia*, genus *Actinobacillus* and genus *Anaerobiospirillum*.

When considering partial genetic information, enzyme analysis and fermentation results of genus *Actinobacillus* and genus *Anaerobiospirillum*, it is clear that the enzymes participating in succinic acid production by genus *Actinobacillus* and genus *Anaerobiospirillum,* are the same as those of genus *Mannheimia,* and that pathways for succinic acid production by genus *Actinobacillus* and genus *Anaerobiospirillum* are the same as that of genus *Mannheimia*[1].

Additionally, it is well known to one skilled in the art that genus *Actinobacillus* and genus *Anaerobiospirillum* produce organic acids by the same metabolic pathway (PEP carboxylation pathway) as that of genus *Mannheimia*.

[1] Van der Werf *et al., Arch. Microbiol.*, 167:332, 1997; Laivenieks *et al., Appl. Environ. Microbiol.*, 63:2273, 1997; Samuelov *et al., App. Environ. Microbiol.*, 65:2260, 1999; Kim *et al., Appl. Environ. Microbiol.*, 70:1238, 2004

Zeikus, J. G. *et al., Appl. Microbiol. Biotechnol.*, 51:545, 1999, at page 548 states that *Anaerobiospirillum succiniciproducens* and *Actinobacillus succinogenees* use the PEP carboxylnase pathway for succinic acid production and have *ldhA, pfl, pta, ackA* and *ppc* gene. See Fig. 2 of such reference, reproduced below for ease of discussion.

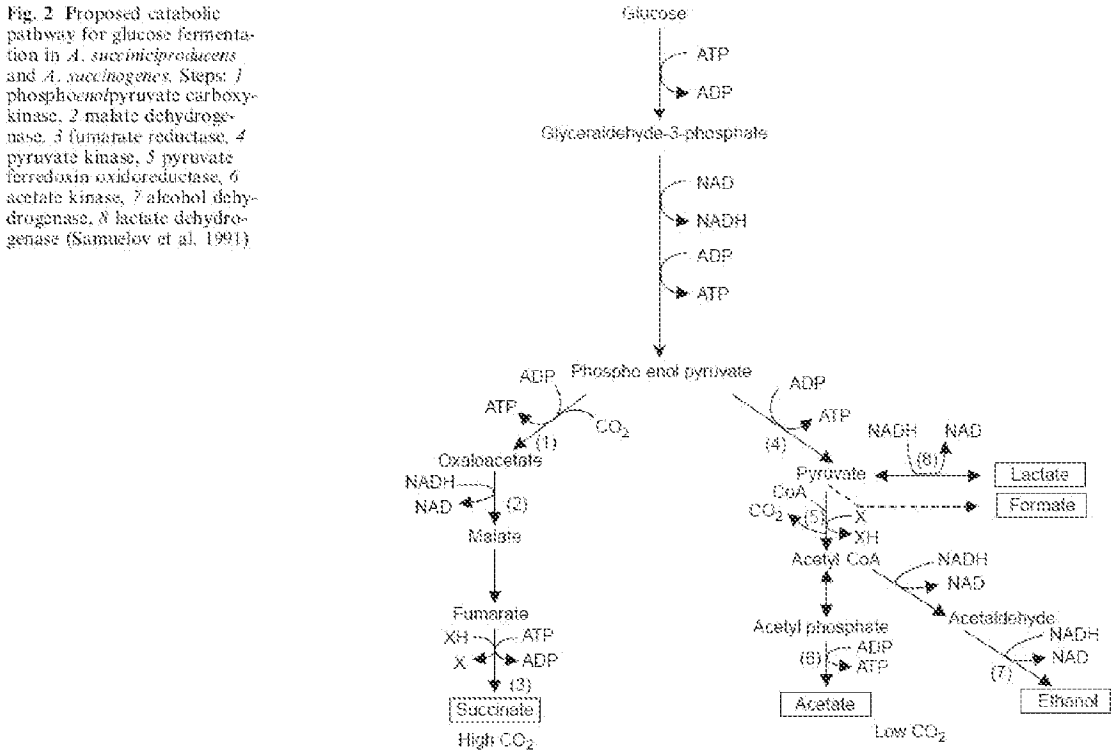

Fig. 2 Proposed catabolic pathway for glucose fermentation in *A. succiniciproducens* and *A. succinogenes*. Steps: *1* phosphoenolpyruvate carboxykinase, *2* malate dehydrogenase, *3* fumarate reductase, *4* pyruvate kinase, *5* pyruvate ferredoxin oxidoreductase, *6* acetate kinase, *7* alcohol dehydrogenase, *8* lactate dehydrogenase (Samuelov et al. 1991)

Further, it is disclosed in Song H.H. & Lee S.Y., *Enzyme and Microbial Technology*, 39:352, 2006, at pages 358-359 of such reference, that "[T]he best candidates for succinic acid production including *A.succinogenes, M.succiniciproducens* and *A.succiniciproducens* use PEP carboxylation pathway to form succinic acid." See also James B. *et al., Appl. Microbiol. Biotechnol.*, 76:727, 2007.

In addition, the Office Action contends that one of ordinary skill in the art would not be able to make any rumen bacteria without undue experimentation because the specification of the present application does not disclose the structures of *ldhA, pfl, pta* and *ackA* genes, i.e., that the specification does not provide enablement for rumen bacterial mutants having disruption of *ldhA, pfl, pta* and *ackA* genes.

In response, it is pointed out that one ordinarily skilled in the art has recourse to genetic engineering techniques known to disrupt *ldhA, pfl, pta* and *ackA* genes that can be applied to the genus *Actinobacillus* and genus *Anaerobiospirillum* as well as to genus *Mannheimia.* The sequences of the above genes can be found in published references or by identifying the homologous region using PCT products exemplified in the example of the present application.

The subject matter of the present invention is a rumen bacterial mutant having disruption of *ldhA, pfl, pta* and *ackA* genes, which produces succinic acid under anaerobic conditions, not the method itself for disrupting genes.

One skilled in the art will readily understand that the same results can be obtained by disrupting *ldhA, pfl, pta* and *ackA* genes in other strains other than genus *Mannheimia,* based on the specification of the present application, and such ordinarily skilled artisan can make a rumen bacterial mutant by disrupting corresponding genes in a strain using known genetic engineering techniques. It is not necessary to describe in the specification all of the genetic engineering methods known for disrupting genes. The preferred embodiment of the invention described in the present application is sufficient to enable one skilled in the art to thoroughly understand the invention. One skilled in the art based on such disclosure is able to make a rumen bacterial mutant without undue experimentation. Thus, the invention recited in claim 2 can readily be practiced by those of ordinary skill in the art on the basis of the disclosure in the present application, without undue empirical effort.

Claim 32 is dependent from claim 2 and is likewise enabled by the disclosure of the present application.

Concerning the rumen bacterial mutant *Mannheimia* sp. LPK7 recited in claims 8 and 9, such bacterial mutant has been deposited in the Korean Collection for Type Cultures, in accordance with the Budapest Treaty. A copy of the Depository Receipt for this material, showing its Accession No. KCTC 10626BP and evidencing receipt of such mutant by the KCTC on April 22, 2004 is attached hereto. It is affirmatively stated that this Depository Receipt is a true and exact copy of the original.

It is further declared that the bacterial mutant thereof has been deposited in accordance with 37 CFR § 1.801-1.809, that during the pendency of the present application, access to such deposit will be afforded to the Commissioner upon request, that all restrictions upon availability to the public will be irrevocably removed upon granting of the patent, that the deposit will be maintained in a public repository for a period of 30 years or 5 years after the last request or for the effective life of the patent, whichever is longer, and that the deposit will be replaced if it should ever become inviable.

Based on the foregoing, claims 2, 8-9, and 32 are patentable over the art and in condition for allowance. Favorable action is requested.

CONCLUSION

Claims 2, 8-9 and 32, as amended herein, are in proper form for allowance. The examiner is requested to favorably consider the foregoing, and to responsively issue a Notice of Allowance. If any issues require further resolution, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same, so that this application may be passed to issue at an early date.

Respectfully submitted,

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The USPTO is hereby authorized to charge any deficiency or credit any overpayment of fees properly payable for this document to Deposit Account No. 08-3284

BUDAPEST TREATY ON THE INTERNATIONAL RECOGNITION OF THE DEPOSIT OF MICROORGANISMS FOR THE PURPOSE OF PATENT PROCEDURE

INTERNATIONAL FORM

RECEIPT IN THE CASE OF AN ORIGINAL DEPOSIT

issued pursuant to Rule 7.1

TO : LEE, Sang Yup
Korea Advanced Institute of Science and Technology,
#373-1, Kuseong-dong, Yuseong-gu, Daejeon 305-701,
Republic of Korea

I. IDENTIFICATION OF THE MICROORGANISM	
Identification reference given by the DEPOSITOR: ***Mannheimia* sp. LPK**	Accession number given by the INTERNATIONAL DEPOSITARY AUTHORITY: **KCTC 10558BP**

II. SCIENTIFIC DESCRIPTION AND/OR PROPOSED TAXONOMIC DESIGNATION

The microorganism identified under I above was accompanied by:
[x] a scientific description
[ ] a proposed taxonomic designation
(Mark with a cross where applicable)

III. RECEIPT AND ACCEPTANCE

This International Depositary Authority accepts the microorganism identified under I above, which was received by it on **November 26 2003.**

IV. RECEIPT OF REQUEST FOR CONVERSION

The microorganism identified under I above was received by this International Depositary Authority on and a request to convert the original deposit to a deposit under the Budapest Treaty was received by it on

V. INTERNATIONAL DEPOSITARY AUTHORITY

Name: **Korean Collection for Type Cultures** Address: Korea Research Institute of Bioscience and Biotechnology (KRIBB) #52, Oun-dong, Yusong-ku, Taejon 305-333, Republic of Korea	Signature(s) of person(s) having the power to represent the International Depositary Authority of authorized official(s): PARK Yong-Ha, Director Date: **November 28 2003**

Form BP/4 (KCTC Form 17)

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